NON-MECHANICAL BLOWER

Cross Reference to Related Applications

This application is a continuation of International Application No. PCT/US02/29820 filed September 19, 2002 and published April 3, 2003 as International Publication No. WO 03/027575, designating the United States, and which claims benefit of U.S. Provisional Application No. 60/323,855 filed September 21, 2001.

Field of Invention

The present invention relates to a non-mechanical blower for use in heating the interior of a motor vehicle, and more particularly, to the use of thermoelectric devices used in tandem to replace conventional electromechanical blower devices.

Background of the Invention

Currently, nearly all motor vehicles have an interior heating system which is connected to the engine cooling system in which a water-coolant mixture is circulated from the vehicle's radiator to the engine where it is heated by the operation of the internal combustion engine. A portion of that heated water-coolant mixture is diverted to a finned or coiled element behind the firewall of the vehicle. Air is directed across this element by a blower driven by an electric motor and conveyed through ducts to the passenger compartment including the vehicle's occupants, windshield, etc.

This type of interior heating system is made up of numerous components, making it quite complex and has the potential in the water-coolant loop to plug due to contaminants and leak at

the various connections. In addition, the system is rather slow to respond, especially to provide heat from a cold start on a winter's day.

Further, with new electric or hybrid vehicles now being sold and a large potential for market growth, the water-coolant system may no longer be available to cool the vehicle as the principal source of power will not be an internal combustion engine.

A number of vehicle heating systems have been disclosed to improve the conventional design. U.S. Patent No. 6,079,485 to Easaki, et al. discloses a vehicle air conditioning system in which the vehicle air conditioner unit and a seat heating and cooling device operate in locked relation. The heater/cooler unit requires an electric fan to distribute the heated cooled air. Likewise, U.S. Patent No. 5,901,572 to Peiffer, et al. discloses an auxiliary heating and air conditioning system comprising a thermoelectric cooler in fluid communication with two fans to transfer air to the passengers. U. S. Patent No. 5,623,828 to Harrington discloses a thermoelectric cooler as an add-on unit that can be positioned at the discharge of a blower and can be plugged into the cigarette lighter receptacle for power. U. S. Patent No. 5,687,573 discloses a thermal control device that can be used for heating or cooling parked cars. Attention also is directed to U. S. Patent No. 3,817,043 to Zolita which discloses an automobile air conditioning system in which the engine exhaust provides a heat source for operating a Seebeck generator used for supplying electrical current to a Peltier unit locked in the passenger space for removing heat from the latter. It too depends on the presence of a fan or blower to move the air. Further discussion of thermoelectric devices can be found in the reference entitled "Investigation into the Use of Thermoelectric Devices as Heat Source for Sink Characterization", by Loh et al, Enertron Inc.

Also, U. S. Patent No. 4,955,203 to Sundhar discloses an air conditioning unit for cooling

a parked automobile comprising at least one solar panel positioned interiorly near the front window for providing power and a cooling unit located in the trunk comprising a cooling chamber and a hot air chamber having fans to assist in air circulation.

What is needed then is a non-mechanical heating device that will be the primary source for heating the interior of the vehicle yet does not require a motor driven blower or liquid coolant.

Summary of the Invention

The present invention addresses this need by providing a series of thermoelectric devices disposed on the inner walls of a conduit for heating a vehicle. The devices are arranged near the top and bottom of the inner walls in alternating and opposing fashion (hot surface, cold surface, hot surface, cold surface, etc.). The cold surfaced panels preferentially are arranged at the crest of baffles that extend a majority of the distance from the top surface of the conduit towards the bottom surface of the conduit and alternate with the hot surfaced panels which are preferentially arranged at the trough portion of baffles that extend from the bottom surface of the conduit a majority of the distance towards the top surface of the conduit. This forms a serpentine pattern which urges air to flow in response to the energy from the thermoelectric devices.

Thermoelectric devices utilize the Peltier phenomenon to provide a silent heat pump having no moving parts to deliver hot or cold air depending on the polarity of the current supplied to the device. A thermoelectric device is a solid-state energy converter which contains arrays of dissimilar semiconductors (the *n*-types and the *p*-types), thermally joined in parallel and electrically joined in series at both ends to form a couple. The *n*-type semiconductor has excess electrons whereas the *p*-type is electron deficient which converts electrical energy to thermal energy and vice versa. The semiconductors *p*-and *n*- couples can be anywhere from a few to

several hundreds aligned electrically in series and thermally in parallel between the two ceramic plates. As current passes through the couples, from *n*-type to *p*-type, it creates a temperature gradient across the thermoelectric device when heat energy is drawn from the cold junction, transported through the semiconductors by electrons (*n*-type) and (*p*-types), and finally, dumps the heat off at the hot junction. If the polarity of the current is reversed, the heat transporting direction reverses accordingly. The amount of heat pumped is in direction proportion to the current supplied.

In the above manner, air flow through the conduit is achieved by natural convection (i.e. the motion that occurs in a fluid at a non-uniform temperature owing to the variation in its density and the action of gravity). More precisely, air heated by a hot surface thermoelectric device disposed along the bottom surface of the conduit rises between baffles towards the next succeeding crest portion of the serpentine air flow pattern. Upon reaching the top of the baffle, the heated air is cooled by a cold surface thermoelectric device and falls between baffles towards the next succeeding trough portion of the serpentine air flow pattern and corresponding hot surface thermoelectric device. Finally, in order to promote air flow through the conduit, the temperature of the hot thermoelectric devices preferably increases from the conduit inlet to the conduit outlet.

In another embodiment, ram air from the vehicle moving forward can be used to assist air flow through the conduit.

In still another embodiment, segments of conduit can be positioned in parallel fashion one atop the other to take maximum advantage of the functioning of a thermoelectric device, that is, the presence of a hot surface on the opposite side from a cold surface or vice versa, thus increasing system efficiency and reducing the number of thermoelectric devices required.

In order to achieve cooling of the vehicle's interior, the hot surface devices can be deactivated and ram air forced across the cold surface devices to cool the occupants.

Brief Description of the Drawings

These and other objects, features and advantages of the invention will become apparent upon consideration of the description of the invention and the appended drawings in which:

Figure 1 is a schematic view illustrating the intent of the invention and the flow path of the heated air; and

Figure 2 is a representative perspective view of a sectioned conduit for a vehicle containing the thermoelectric devices illustrating one embodiment of the invention.

The above and other objects, features and advantages of the present invention will be apparent in the following detailed description thereof when read in conjunction with the appended drawings wherein the same reference characters denote the same or similar paths throughout the several views.

Description of the Preferred Embodiments

For elements common to the various embodiments of the invention, the numerical reference character between the embodiments is held constant, but distinguished by the addition of an alphanumeric character to the existing numerical reference character. In other words, for example, an element referenced at **10** in the first embodiment is correspondingly referenced at **10A, 10B**, and so forth in subsequent embodiments. Thus, where an embodiment description uses a reference character to refer to an element, the reference character applies equally, as distinguished by alphanumeric character, to the other embodiments where the element is common.

As noted above, Figure 1 is a schematic illustrating the relative position of the elements of the invention and the flow of the warmed air. The structure comprises a conduit **10** having a series of baffles **11** extending across the conduit but leaving a space at the bottom or top of each alternating baffle to create a serpentine path for air to flow from the intake **12** or inlet, past alternating cold and hot surface thermoelectric devices and exit through the exhaust **13** to warm a vehicle's interior. Arranged along the inside wall of the conduit **10** at the top are cold surface thermoelectric devices **14** alternating with hot surface thermoelectric devices **15** at the bottom of the conduit. In addition, the hot surface devices **15** are set at a progressively higher operating temperatures as the air proceeds from intake **12** to exhaust **13**. In this fashion, convection causes the cooler air from the cold surface devices **14** to flow downward due to the higher specific gravity until it encounters the hot surface device **15** which forces the air to flow upward through the next channel between baffles in the conduit. To urge air flow even further, a small amount of ram air can be introduced from the exterior of the vehicle through an air intake or grille opening when the vehicle is moving to feed the intake **12.**

Turning to Figure 2, a prospective view of a conduit with one side removed is shown. An opening **12A** at one end is the inlet for air flow which is caused by a cold surface thermoelectric device being activated at **14A**. As the cooled air moves downward due to its higher specific gravity between the baffles **11A**, it encounters a hot surface thermoelectric device **15A**, which has been activated causing the air to flow upward due to the convection process. Each succeeding hot surface device **16, 17, 18,** etc. (also indicated as **H**) is set at a higher activation temperature than the previous surface device to urge the flow of air to the conduit **13A**, and into the passenger compartment. Correspondingly, the cold surface devices are indicated as **C**.

In other embodiments, finned heat sinks of aluminum or copper can be attached to the hot

and cold surfaces to promote heat transfer, and insulation can be employed to reduce heat losses from the conduit.

Thus, it can be seen that the invention is novel in that it provides an apparatus to heat the interior of a vehicle having no electromechanical devices to move the air.